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Science | Sciences
Newfoundland and Labrador Region
Canadian Science Advisory Secretariat
Science Response 2012/003

MONITORING UPDATE FOR THE ASSESSMENT OF NORTHERN SHRIMP (*Pandalus borealis*) IN SHRIMP FISHING AREAS 4-6 (NAFO DIVS. 2G-3K)

Context

Northern Shrimp, *Pandalus borealis*, in Shrimp Fishing Areas (SFA) 4-6 were last assessed in March 2011. During that assessment, it was noted that the shrimp resource in SFA 6 had been in decline since 2006. The resource was in the Cautious zone within the harvest control rules provided within Annex I of the Integrated Fisheries Management Plan (IFMP) (online available at http://www.dfo-mpo.gc.ca/fm-gp/peches-fisheries/ifmp-gmp/shrimp-crevette/shrimp-crevette-2007-eng.htm). The 2011 zonal advisory process (ZAP) concluded that status of these stocks would continue to be fully assessed biennially based on the Precautionary Approach (PA) framework with the next assessment scheduled for March 2013. However, due to continued concern over the decline in SFA 6 stock status, Ecosystems and Fisheries Management (EFM) within Fisheries and Oceans Canada (DFO) requested an update of resource status before developing harvesting strategies for the 2012/13 fishing season. A Canadian Science Advisory Secretariat (CSAS) Science Special Response process was held by teleconference and WebEx on February 20, 2012. The objective of this process was to update the indices for the Precautionary Approach framework for the status of Northern Shrimp in SFAs 4-6 through the 2011/12 fishing season.

Within SFA 6, the female spawning stock biomass (SSB) index had increased by 27% since 2010 and was at 242,000 t in 2011 and was assessed to be in the Healthy zone. However, there is a small chance that the SSB remains within the Cautious zone. The fishable biomass index had increased by 38% since 2010 and was at 409,000 t in 2011.

The biomass indices within SFA 5 had not significantly changed since 2001, while those within SFA 4 had not significantly changed since 2007. The lower bounds of the 95% confidence intervals around the 2011 SSBs for SFAs 4 and 5 were within the Healthy zones for the respective SFAs.

This Science Response Report is from the Fisheries and Oceans Canada, Canadian Science Advisory Secretariat Zonal Science Special Response Process of February 20, 2012 updating the assessment of Northern Shrimp stocks in SFAs 4-6.

Background

Stock status was based upon the qualitative assessment of commercial catch versus Total Allowable Catch (TAC), as well as indices of biomass from the research bottom trawl survey. The meeting concluded that the commercial catch would probably be taken in all SFAs.

Fishable biomass is derived as the weight of all shrimp with carapace lengths > 17 mm. In SFAs 5 and 6, the DFO research survey is at the end of the fishery season, therefore, the exploitation rate index is total catch/ previous year fishable biomass expressed as a percentage. In SFA 4, the Northern Shrimp Research Foundation – DFO research survey is during the middle of the fishing

season, therefore, the exploitation rate index is total catch/ within year fishable biomass expressed as a percentage.

Analysis and Responses

SFA 6 (Hawke Channel and NAFO Div. 3K)

Commercial Fishery

The SFA 6 resource had been in decline since 2006 and therefore, under the Integrated Fisheries Management Plan (IFMP) PA framework, the 2010/11 TAC was reduced to 61,632 t in 2010/11 and further to 52,837 t in 2011/12 (Fig. 2). Preliminary data indicate that the 2011/12 TAC had been taken by February 6, 2012 (Table 1).

Biomass

Fishable biomass in the fall RV survey increased significantly from 433,000 t in 2003 to nearly 670,000 t in 2006, decreased by 56% to about 300,000 t by 2010 and then increased significantly by 36% to 409,000 t in 2011 (Table 1). The female spawning stock biomass index showed a similar pattern, declining from by 59% from 460,000 t in 2006 to 190,000 t in 2010 and then increasing by 27% to 241,000 t in 2011 (Table 1, Fig. 3).

There is uncertainty related to the increase in biomass indices in 2011 because of steady declines in recruitment indices since 2006.

Mortality

Based upon preliminary data to February 6, 2012, the 2011/12 exploitation rate index will be at least 18%. If the 2011/12 TAC of 52,387 t was maintained through 2012/13 and this quota was taken, the exploitation rate index would decrease to 13% (Table 1, Fig. 4). There have been major increases and decreases in biomass indices even though the average exploitation rate over the 1996-2011/12 time series has been a modest 14%. There are probably several factors such as predators, competitors, food and the physical environment that play important roles in Northern Shrimp population dynamics within SFA 6.

Precautionary Approach Framework

The female spawning stock biomass (SSB) index is assessed to be in the Healthy zone, however, there is a small chance that the SSB remained in the Cautious zone (Fig. 5).

SFA 5 (Hopedale and Cartwright Channels)

Commercial Fishery

The 2003/04 TAC (23,300 t) was maintained through 2011/12 and has been taken in most years. Approximately 22,500 t were taken by February 6, 2012 and it is anticipated that the TAC will be taken (Table 2, Fig. 6).

Biomass

Annual fall multi-species surveys were conducted in the northern part of SFA 5 (NAFO Div. 2H) between 1996 and 1999. Since then, surveys of the whole of SFA 5 were completed in only six (2001, 2004, 2006, 2008, 2010 and 2011) of the last twelve years. However, the southern portion of SFA 5 (Cartwright Channel) has been surveyed each year since 1996. In the years that all of SFA 5 has been surveyed, trends in indices and biological characteristics for the entire area and the Cartwright Channel portion were broadly consistent (Table 2, Fig. 7).

SSB and fishable biomass indices increased after 1999. SSB and fishable biomass indices within the entire of SFA 5 have remained relatively stable at between 65,000 t and 86,000 t, and 128,000 t and 155,000 t respectively since 2001(Table 2, Figs. 7 and 8).

Mortality

The exploitation rate index has varied without trend between 15-20% over much of the time series Table 2, Fig. 9). There has been relative stability in the fishable biomass for the past decade and the average exploitation rate index over this period has been 15%.

Precautionary Approach

SSB was assessed to be in the Healthy zone of the PA Framework (Fig. 10).

SFA 4 (NAFO Div. 2G)

Commercial Fishery

A TAC of 11,300 t was maintained from 2008/09 through to 2011/12. Preliminary data indicate that 11,000 t were taken by February 6, 2012 and it is anticipated that the TAC will be taken (Table 3, Fig. 11).

Biomass

Both SSB and fishable biomass indices remained stable over the period 2007–2011. The current SSB index is 87,000 t while the fishable biomass index is 130,000 t (Table 3, Fig. 12).

Mortality

Over the period 2007/08–2011/12, the exploitation rate has been about 9% (Table 3, Fig. 13). It is important to note that even though the 2011/12 exploitation rate index will be approximately 9%, the 95% confidence intervals around the 2011/12 exploitation rate index will range between 5 and 16% (Table 3, Figs. 13 and 14).

Precautionary Approach

Female spawning stock biomass is currently assessed to be in the Healthy zone under the PA Framework (Fig. 14).

Conclusions

SFA 6

- Within SFA 6, the female spawning stock biomass (SSB) index had increased by 27% since 2010 and was at 242,000 t in 2011. The 2011 fishable biomass index was 409,000 t, a 38% increase since 2010.
- Female spawning stock biomass (SSB) index was assessed to be in the Healthy zone, however, there is a small chance that the SSB index remains within the Cautious zone (Fig. 5).
- If the 2011/12 TAC is maintained through 2012/13, and is taken, the exploitation rate index will be 13%.

SFA 5

- Current status remains positive. SSB index was assessed to be in the Healthy Zone of the PA framework.
- There has been relative stability in the fishable biomass index for the past decade and the average exploitation rate index over this period has been 15%.
- If the 2011/12 TAC is maintained through 2012/13, and is taken, the exploitation rate index will be 16%.

SFA 4

- Current status remains positive. Biomass indices have changed little since 2006. The SSB index was assessed to be in the Healthy Zone of the PA framework, well above the USR. The exploitation rate has been about 9% since 2005.

Sources of Information

DFO. 2007. Integrated Fisheries Management Plan: Northern Shrimp - Shrimp Fishing Areas (SFAs) 0-7 and the Flemish Cap. http://www.dfo-mpo.gc.ca/fm-gp/peches-fisheries/ifmp-gmp/shrimp-crevette/shrimp-crevette-2007-eng.htm.

DFO. 2011. Assessment of Divisions 2G-3K Northern Shrimp. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2011/003.

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Tables and Figures

Table 1. SFA 6 (Hawke Channel + NAFO Div. 3K) Northern Shrimp fishable biomass, exploitation rate and female spawning stock biomass (SSB) indices from autumn Canadian research bottom trawl survey data, 1996 – 2011.

Catch Year	Catch (t)	Survey Year	Fishable biomass (t)			Exploitation rate index Catch/ previous year fishable Biomass (%)			Female Spawning Stock biomass (t)		
			Lower C.I.	Index	Upper C.I.	Lower C.I.	Index	Upper C.I.	Lower C.I.	Index	Upper C.I.
1997	21,018	1996	240,625	315,128	378,960	5.55	6.67	8.73	149,006	200,957	243,545
1998	46,337	1997	257,237	309,692	345,232	13.42	14.96	18.01	145,583	183,439	211,227
1999	51,202	1998	313,014	359,025	398,290	12.86	14.26	16.36	184,446	214,046	240,222
2000	63,224	1999	355,904	411,681	465,343	13.59	15.36	17.76	223,006	260,459	297,610
2001	52,590	2000	359,226	416,513	472,391	11.13	12.63	14.64	247,673	299,020	338,788
2002	60,384	2001	441,381	520,616	618,276	9.77	11.60	13.68	290,764	353,085	424,870
2003/04	71,227	2002	425,574	491,016	540,048	13.19	14.51	16.74	298,315	349,058	385,302
2004/05	77,820	2003	362,347	432,622	483,264	16.10	17.99	21.48	263,580	323,183	366,475
2005/06	75,231	2004	399,599	454,671	523,133	14.38	16.55	18.83	325,498	378,859	436,851
2006/07	75,673	2005	421,547	505,112	570,252	13.27	14.98	17.95	325,599	395,471	450,946
2007/08	80,736	2006	555,250	669,824	791,445	10.20	12.05	14.54	389,128	462,927	541,457
2008/09	75,080	2007	476,720	566,224	638,613	11.76	13.26	15.75	353,286	430,105	493,231
2009/10	45,099	2008	434,031	509,944	585,555	7.70	8.84	10.39	285,327	339,996	407,653
2010/11	61,500	2009	232,168	310,698	422,957	14.54	19.79	26.49	159,477	204,984	276,165
2011/12	53,332*	2010	247,371	295,395	343,117	15.54	18.05*	21.56	154,342	190,185	222,704
2012/13	52,387**	2011	348,554	408,660	472,290	11.09	12.82**	15.03	202,266	241,733	283,918

* Catch as of February 6, 2012 as fishery ongoing

** assumes that the 2011/12 TAC of 23,300 t will be maintained in 2012/13.

Table 2. SFA 5 (Hopedale and Cartwright Channels) Northern Shrimp fishable biomass, exploitation rate index and female spawning stock biomass (SSB) index from autumn Canadian research bottom trawl survey data, 1996 –2011.

Catch Year	Catch (t)	Survey Year	Fishable biomass (t)			Exploitation rate index Catch/ previous year fishable Biomass (%)			Female Spawning Stock biomass (t)		
			Lower C.I.	Index	Upper C.I.	Lower C.I.	Index	Upper C.I.	Lower C.I.	Index	Upper C.I.
1997	15,103	1996	46,403	86,283	145,080	10.41	17.50	32.55	21,868	33,224	47,753
1998	15,170	1997	70,164	101,787	137,428	11.04	14.90	21.62	28,553	39,668	50,290
1999	15,109	1998	50,511	70,677	100,781	14.99	21.38	29.91	26,851	37,956	50,239
2000	14,694	1999	62,935	90,813	128,669	11.42	16.18	23.35	33,506	50,139	69,016
2001	15,116	2000									
2002	15,339	2001	137,428	183,540	246,867	6.21	8.36	11.16	67,174	96,451	129,273
2003/04	30,437	2002									
2004/05	22,785	2003									
2005/06	22,904	2004	102,492	150,617	200,555	11.42	15.21	22.35	61,928	86,484	110,547
2006/07	22,612	2005									
2007/08	23,768	2006	125,548	155,349	196,024	12.13	15.30	18.93	60,851	81,651	106,721
2008/09	20,503	2007									
2009/10	25,094	2008	73,063	128,367	198,440	12.65	19.55	34.35	45,457	82,155	126,051
2010/11	21,425	2009									
2011/12	23,300*	2010	76,003	144,979	226,832	10.27	16.07*	30.66	35,701	64,637	99,925
2012/13	23,300**	2011	113,466	144,677	184,446	12.63	16.10**	20.53	52,797	75,510	103,197

* Catch prorated to TAC as fishery ongoing

** assumes that the 2011/12 TAC of 23,300 t will be maintained in 2012/13.

Table 3. SFA 4 (NAFO Div. 2G) Northern Shrimp fishable biomass exploitation rate index and female spawning stock biomass (SSB) from autumn Canadian research bottom trawl survey data, 1996 – 2011.

Year	Catch (t)	Fishable biomass biomass (t)			Exploitation rate index Catch/ within year fishable Biomass (%)			Female Spawning Stock biomass (t)		
		Lower C.I.	Index	Upper C.I.	Lower C.I.	Index	Upper C.I.	Lower C.I.	Index	Upper C.I.
2005	10,247	29,399	62,321	102,694	9.98	16.44	34.86	17186.076	34533.24	52806.66
2006	10,084	45,618	92,424	135,717	7.43	10.91	22.10	30,597	53,360	72,832
2007	10,009	72,560	113,970	176,593	5.67	8.78	13.79	54,297	80,846	121,219
2008	9,682	74,463	119,004	194,715	4.97	8.14	13.00	53,058	88,296	157,262
2009	10,656	94,307	179,512	370,603	2.88	5.94	11.30	66,831	130,985	272,339
2010	11,134	59,039	127,058	255,324	4.36	8.76	18.86	28,825	70,879	150,013
2011	11,320*	71,956	129,777	248,176	4.56	8.72*	15.73	57,478	87,491	147,798

* catch prorated to TAC as fishery was ongoing.

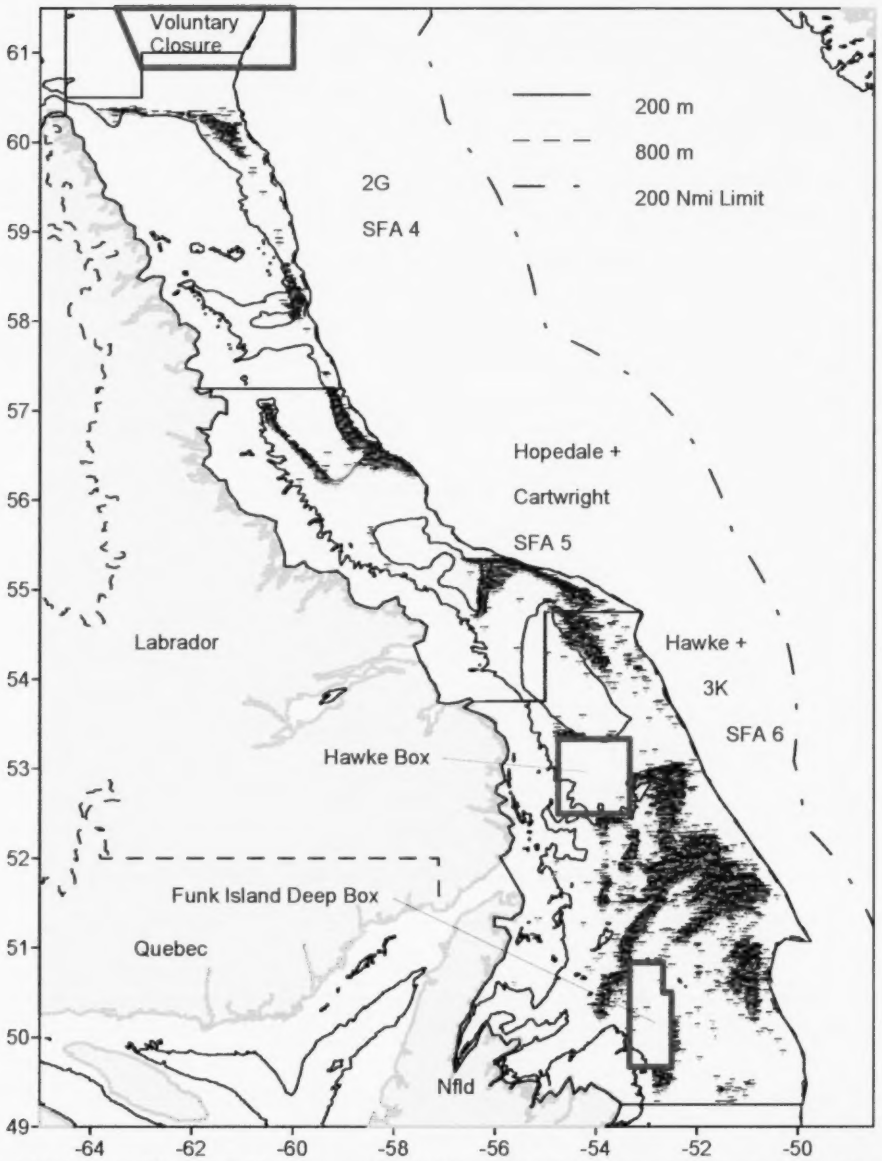

Figure 1 Map of Northern Shrimp fishing areas (SFAs) including the large vessel voluntary, Hawke Channel and Funk Island Deep closed areas. The red crosses indicate large and small vessel fishing positions during 2011/12.

Figure 2. Historical Northern Shrimp catches and TACs in SFA 6, for the period 1977 – 2011/12 (2011/12 catch is preliminary). In 2003, the management year changed to a fiscal year.

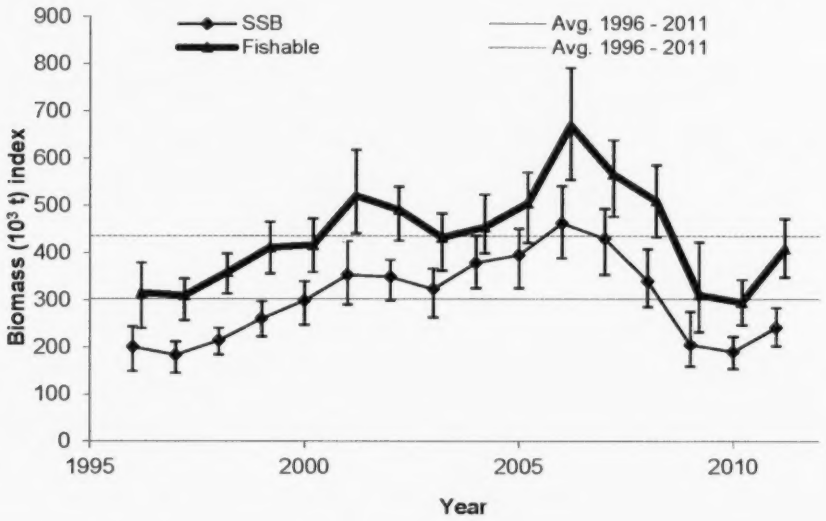

Figure 3. SFA 6 biomass indices (error bars indicate 95% confidence intervals).

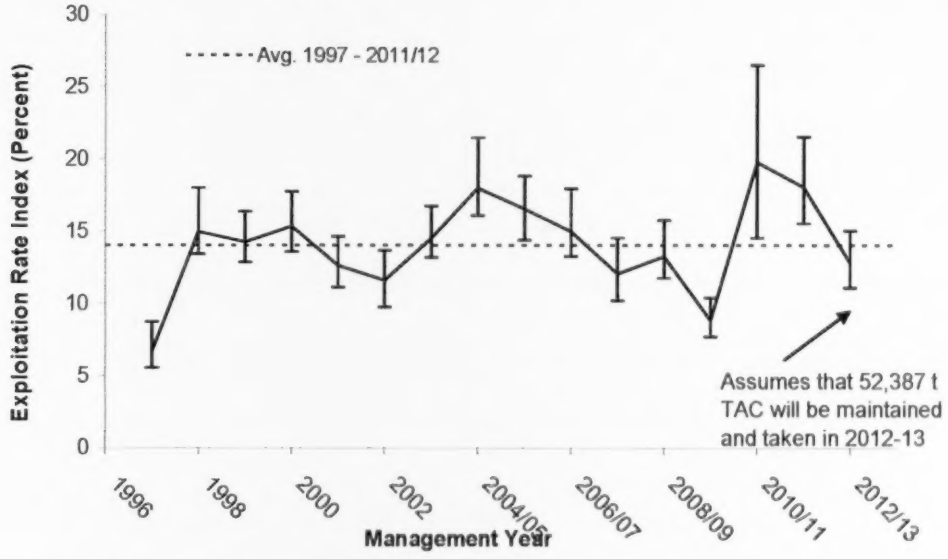

Figure 4. SFA 6 exploitation rate index based on the total catch/fishable biomass index from the previous year, expressed as a percentage. Error bars indicate 95% confidence intervals. The 2011/12 value is preliminary as the fishery was ongoing. The 2012/13 exploitation rate index assumes that the 2011/12 TAC of 52,387 t will be maintained through 2012/13.

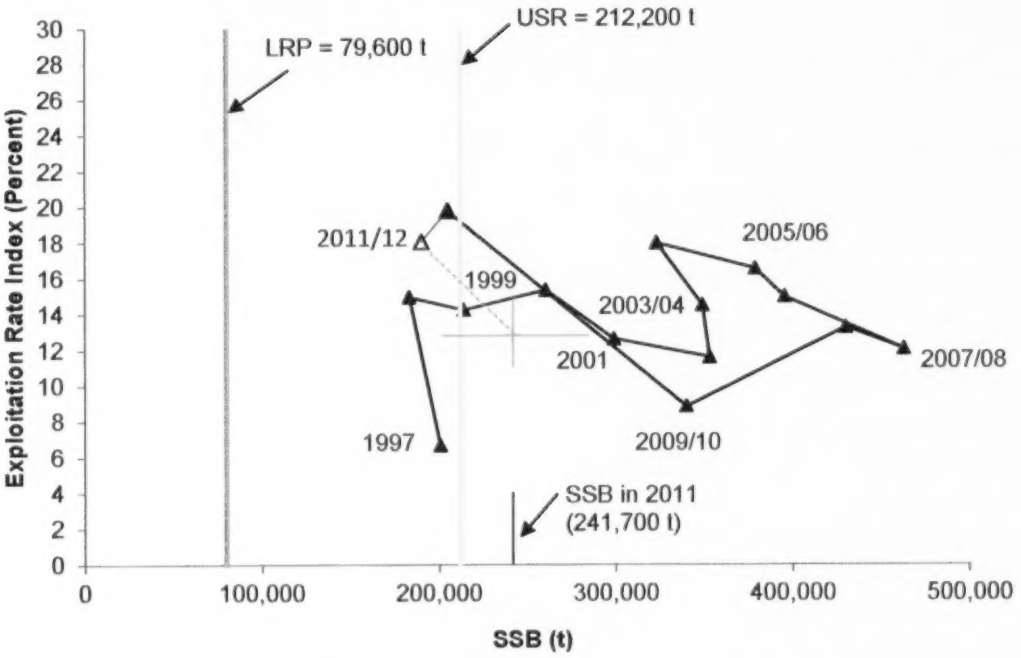

Figure 5. SFA 6 Precautionary Approach framework with trajectory of exploitation rateindex vs SSB. Numbers denote management year. The exploitation rate index for 2011/12 was as of February 6, 2012 (open triangle). The red cross indicates the 95% confidence interval for the autumn 2011 SSB index (horizontal bar), and the exploitation rate index if the 2011/12 TAC of 52,387 t is maintained (vertical bar) through 2012/13.

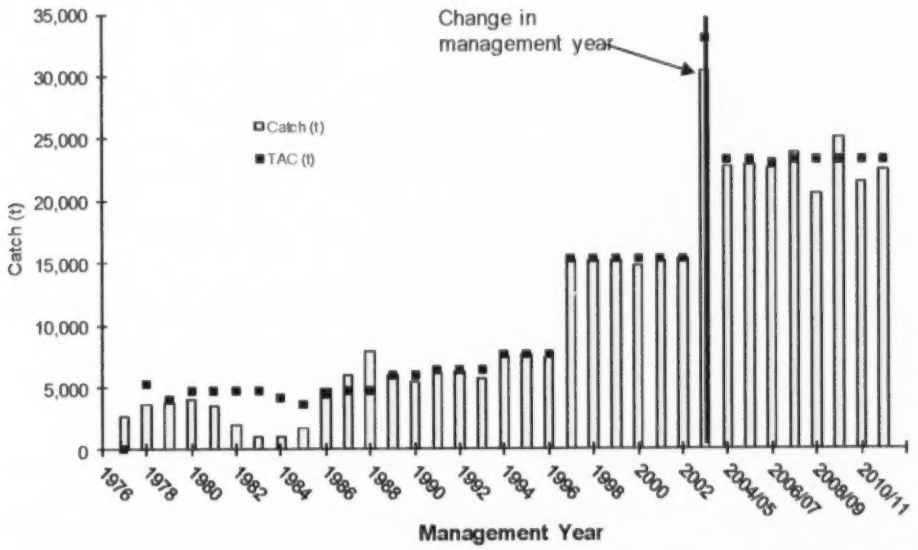

Figure 6. Historical Northern Shrimp catches and TACs in SFA 5, for the period 1977– 2011/12 (2011/12 catch is preliminary). In 2003, the management year changed to a fiscal year.

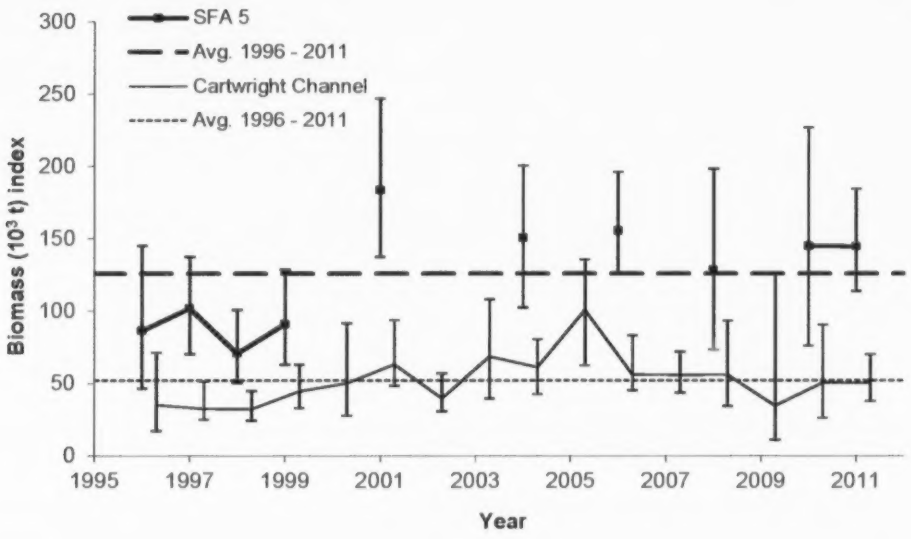

Figure 7. Fishable biomass index within the entire of SFA 5 and Cartwright Channel (error bars indicate 95% confidence intervals).

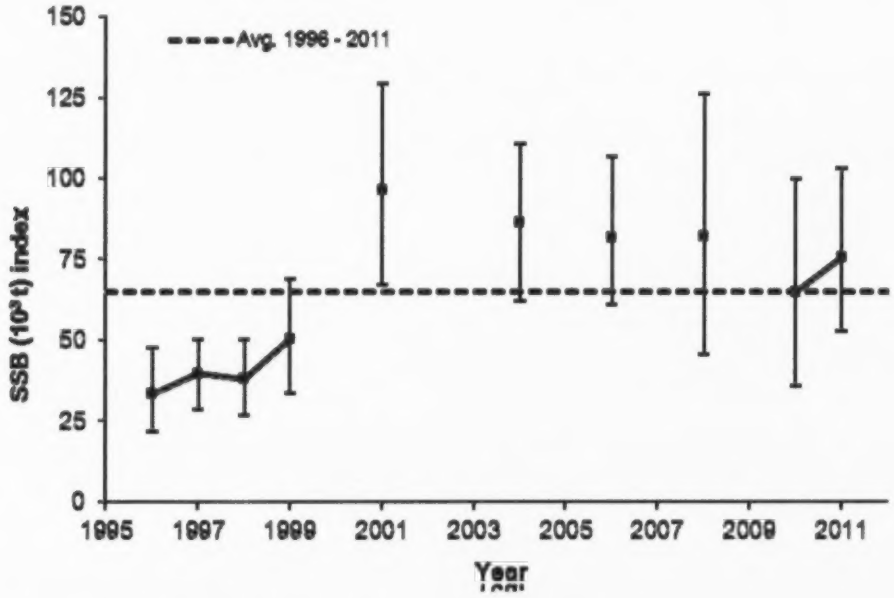

Figure 8. SFA 5 SSB index (error bars indicate 95% confidence intervals).

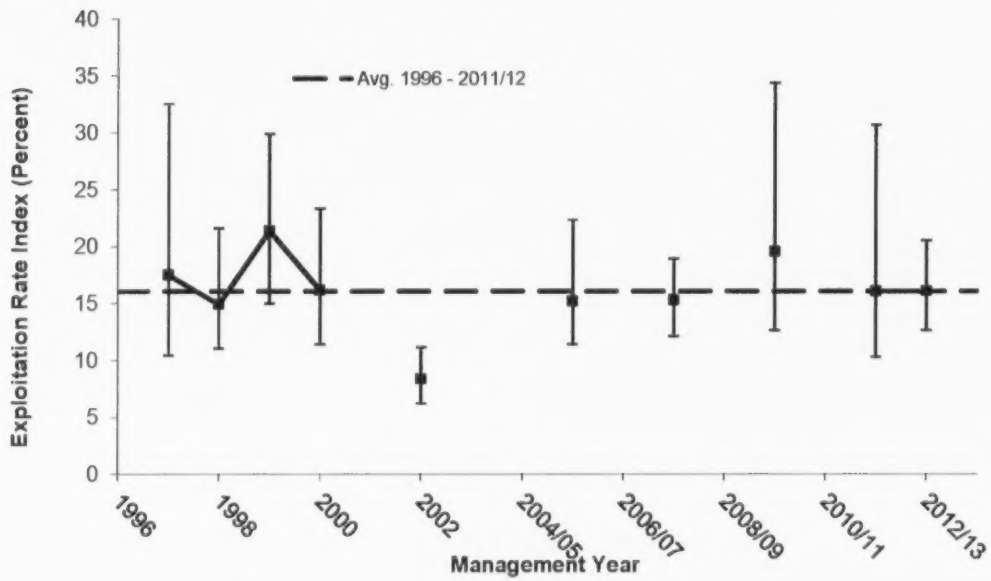

Figure 9. SFA 5 exploitation rate index over the period 1996–2011/12 (error bars indicate 95% confidence intervals). The 2011/12 value was prorated to the TAC as the fishery was ongoing. The 2012/13 value assumes that the 2011/12 TAC of 23,300 t will be maintained through 2012/13.

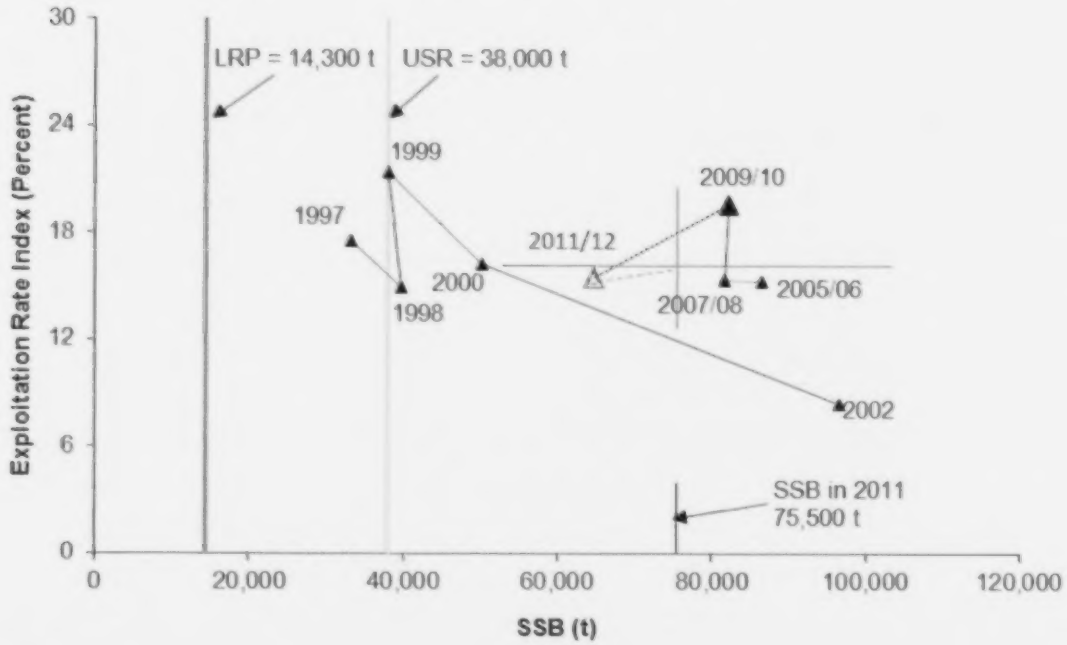

Figure 10. SFA 5 Precautionary Approach framework with trajectory of exploitation rate index vs SSB. Numbers denote management year. The exploitation rate index for 2011/12 was as of February 6, 2012 (open triangle). The red cross indicates the 95% confidence interval for the autumn 2011 SSB index (horizontal bar), and the exploitation rate index if the 2011/12 TAC of 23,300 t is maintained (vertical bar) through 2012/13.

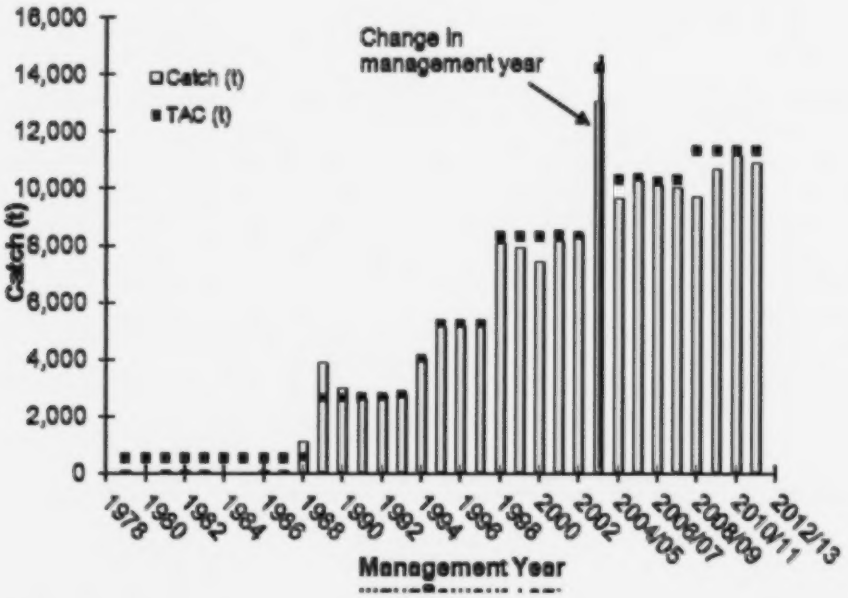

Figure 11. Historical Northern Shrimp catches and TACs in SFA 4, for the period 1979 – 2011/12 (2011/12 catch is preliminary). In 2003, the management year changed to a fiscal year.

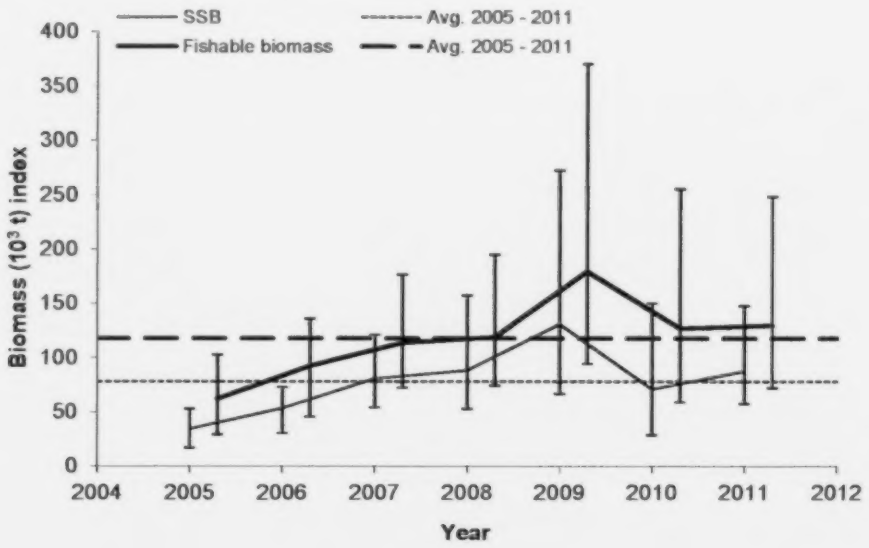

Figure 12. SFA 4 biomass indices (error bars indicate 95% confidence intervals).

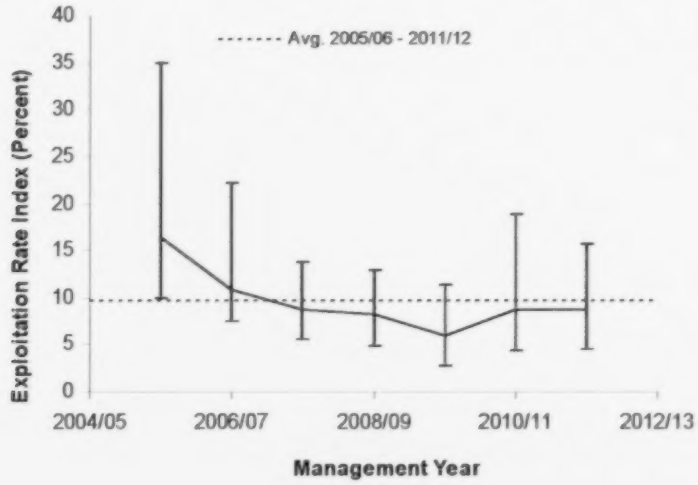

Figure 13. SFA 4 exploitation rate index. (total catch/fishable biomass index from the same year; error bars indicate 95% confidence intervals). The 2011/12 value was prorated to the TAC as the fishery was ongoing.

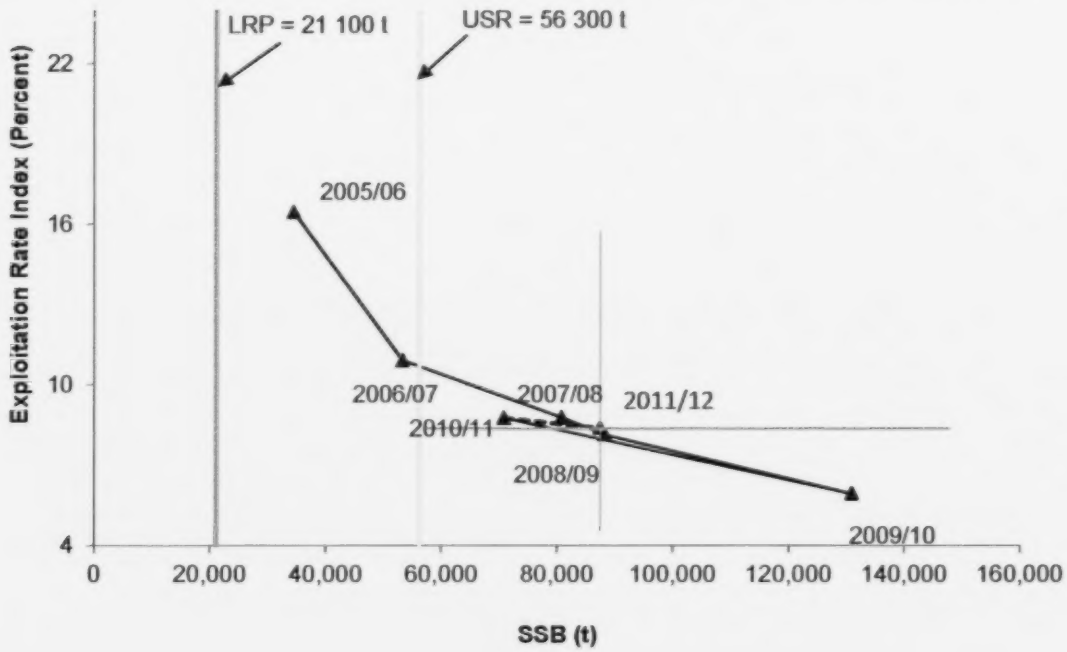

Figure 14. SFA 4 Precautionary Approach framework with trajectory of exploitation rate index vs SSB. Numbers denote management year. The exploitation rate index for 2011/12 was as of February 6, 2012 (open triangle). The red cross indicates the 95% confidence interval for the autumn 2011 SSB index (horizontal bar), and the 2011/12 exploitation rate index (vertical bar).

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